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13. ABSTRACT (Maximum 200 words) The symposium "New Materials for Nonlinear Optics" was held at the American Chemical Society National Meeting, in Boston on April 22-26, 1990. The meeting was a success. Throughout the week the average attendance was over 150 people/session. Several speakers had attendance over 300. The ACS organized a press conference about the meeting, held on Wednesday April 25, 1990 at 2 pm. At that time, the organizers devoted considerable time to educating the press about the importance of NLO research and the potential impact the NLO devices will have on the average person. The American Chemical Society is publishing an "ACS Symposium Series" monograph edited by the symposium organizers, to provide a permanent record of the proceeding of this meeting.			
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**REPORT ON SYMPOSIUM ENTITLED:  
"NEW MATERIALS FOR NONLINEAR OPTICS"**

**Organized by: Seth Marder, Galen Stucky and John Sohn**

The symposium "New Materials for Nonlinear Optics" was held at the American Chemical Society National Meeting, in Boston on April 22-26, 1990. The organizers had several specific goals in mind throughout the organization of this symposium. They were:

- 1) to expose chemists with little or no background in nonlinear optics (NLO) to the fundamental issues and concepts needed undertake an active NLO research program,
- 2) to provide a forum so that researchers with backgrounds in organic, semiconductor, organometallic, inorganic, polymer, crystal, and device NLO issues, could present distinctly different (sometimes antagonistic) viewpoints on the state of the art and future NLO research,
- 3) to expose US researcher to NLO research taking place in different countries,
- 4) to target research areas, we believed should contribute to future NLO research, but to date have been somewhat neglected by the NLO community,
- 5) to involve students and postdoctoral associates in the symposium,

Examination of the table of the schedule and the contents of the associated book (see attached) and the following description shows how we attempted to implement these goals:

- 1) On Sunday April 22, 1990 we held a full day tutorial to familiarize chemists with the followings topics; introduction to  $\chi^{(2)}$  materials, introduction to  $\chi^{(3)}$  materials; introduction to  $\chi^{(2)}$  device issues, introduction to waveguided NLO applications, characterization of NLO materials, the role of theory for the design of NLO materials, and an overview of NLO materials. We anticipated an attendance of 50-75 peoples for these tutorials. The average attendance on Sunday was 200 people necessitating a change of venue to a ballroom. To further ensure that fundamental concepts were communicated to the chemists in the audience, several speakers gave overview talks. In particular, Daniel Chemla lectured on quantum well devices and Alistair Glass lectured on photorefractive materials,
- 2) the papers struck a balance among many different fields. No two consecutive sessions focused on the same topic and within a given session there were typically a variety topics covered. We chose this format to encourage the audience to sit through topics which were perhaps not directly related to their specific field of expertise,
- 3) speakers from England, France, Israel, Canada, Japan and China participated. The one change in the schedule was the cancellation of Dr. Wegner's presentation. Shortly before the meeting he sent us a FAX informing us that due to the rapid political changes, his presence was required in Germany. In Dr. Wegner's place, Dr. Seddon, from the University of Sussex, presented a paper on

polymer/crystalline composites. A paper relating to this work has recently appeared in Nature,

4) specific areas we targeted for inclusion in this symposium included: organometallic materials, quantum confined semiconductor clusters, hydrogen bonding and its impact on determining crystal structures, self assembly of polar structures, inclusion phenomena, factors determining the structures of LB films and biomolecules,

5) papers from twelve students or postdoctoral associates were presented. The presenter received \$250 to help cover travel costs.

Perhaps the most obvious indication of the success of this symposium was the attendance. Throughout the week the average attendance was ~150 people/ session. Several sessions had peak attendances over 300. The last talk in the symposium held Thursday afternoon at 5PM had 50 people. The attendance was high and persistent. We estimate that roughly 800 different people attended the symposium for at least part of a session. This represents a considerable fraction of the ~11,000 scientists registered for the meeting. The ACS organized a press conference about the meeting, held on Wednesday April, 25, 1990 at 2 PM. At that time, the organizers devoted considerable time to educating the press about the importance of NLO research and the potential impact the NLO devices will have on the average person.

Our primary goal was to teach chemists about nonlinear optical research. There has never been a symposium designed with this specific goal in mind. As such, we believe that the symposium "New Materials for Nonlinear Optics" will have an important impact on chemists. It will be interesting to follow the number of papers presented at ACS meetings or published in chemical journals on NLO research over the next few years. The American Chemical Society is publishing an "ACS Symposium Series" monograph edited by the symposium organizers, to provide a permanent record of the proceeding of this meeting. It This monograph, entitled *Materials for Nonlinear Optics: Chemical Perspectives*, ACS Symposium Series 455 will be published late in February 1991. Attached is a copy of the table of contents for this book.

The final budget statement for the meeting is enclosed for your records.



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There are some minor  
changes.  
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**NEW MATERIALS FOR NONLINEAR OPTICS**

Seth R. Marder, John E. Sohn, and Galen D. Stucky, organizers

Symposium Co-sponsored by the Division of Organic Chemistry  
and the Division of Inorganic Chemistry  
Crosslisted by the Division of Polymer Chemistry

Sunday, April 22, 1990 - Morning Session

Tutorial on Nonlinear Optics - Galen Stucky, presiding

- 9:00 Tutorial on the Design and Characterization of Materials for  
Second Order Nonlinear Optics - **David J. Williams**
  
- 9:45 Third-Order Nonlinear Optical Effects in Molecular and Polymeric  
Materials - **Paras N. Prasad**
  
- 10:30 Break
  
- 10:45 Electro-Optic Polymer Waveguide Devices: Status and  
Applications - **Rick Lytel** and **Ferris Lipscomb**
  
- 11:30 Waveguiding and Waveguide Applications of Nonlinear Organics -  
**George I. Stegeman** and **Raymond Zanoni**

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**Sunday, April 22, 1990 - Afternoon Session**

**Tutorial on Nonlinear Optics - Seth Marder, presiding**

- 2:00 Studies of Nonlinear Optical Properties of Molecular and Polymeric Materials - J. W. Perry**
- 2:45 The Chemical Structure Dependence of Electronic Hyperpolarizabilities - David N. Beratan**
- 3:30 Break**
- 3:45 Nonlinear Optical Materials: The Great and Near Great - David F. Eaton**

American Chemical Society National Meeting  
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Monday, April 23, 1990 - Morning Session

Organic Small Molecules - A.F. Garito, presiding

8:50 Opening Remarks - **Seth R. Marder**

8:55 Opening Remarks - **A.F. Garito**

9:10 The Quadratic Electrooptic Effect in Small Molecules - **C.W. Dirk**

9:40 Chemistry of Anomalous-Dispersion Phase-Matched Second Harmonic Generation - **Paul A. Cahill**

10:10 Molecular and Macroscopic Second-Order Optical Nonlinearities of Organic and Organometallic Molecules - **Seth R. Marder**, B.G. Tiemann, J.W. Perry, L.-T. Cheng, and W. Tam

10:40 Break

10:55 Purple Membrane Nonlinear Optics and Applications - **Aaron Lewis**, Jung Y. Huang, and Zhingping Chen

11:25 The Design of New NLO-Active Polymers Incorporating Polaronic or Bipolaronic Charge States - **Charles W. Spangler**

11:55 Head-to-Tail Chromophore Assemblies in Oriented, Electro-optic Thin Films - **H.E. Katz**, M.L. Schilling, W.R. Holland, and T. Fang

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**Monday, April 23, 1990 - Afternoon Session**

**Inorganics and Semiconductors - Galen Stucky, presiding**

- 2:00    Opening Remarks - Galen Stucky**
- 2:05    Optoelectronics of Quantum Confined Semiconductor Structures -  
         D.S. Chemla**
- 2:35    Preparation and Characterization of Small Semiconductor  
         Particulates - Norman Herron**
- 3:05    Synthesis and Characterization of Small Particle Semiconductors  
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- 3:25    Break**
- 3:40    Intrazeolite Metal Carbonyl Phototopotaxy: From Tungsten(VI)  
         Oxide Quantum Dots to an Expanded Semiconductor Quantum  
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- 4:00    Inorganic Sol-Gel Glasses as Matrices for NLO Materials - E.T.  
         Knobbe, E.-W. Chang, J. McKiernan, B. Dunn, R.B. Kaner, and  
         J.I. Zink**
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Crosslisted by the Division of Polymer Chemistry

**Tuesday, April 24, 1990 - Morning Session**

$\chi^{(2)}$  Polymers - Gary Bjorklund, presiding

9:00      Opening Remarks - Gary Bjorklund

9:15      Rational Design, Construction, and Processing of Organic  
Polymers Having Very Large Optical Nonlinearities - **T.J. Marks**,  
G.K. Wong, D. Dai, M.A. Hubbard, N. Minami, J.W. Park, and J.  
Yang

9:45      Synthesis and Characterization of a Novel Covalently  
Functionalized Amorphous  $\chi^{(2)}$  NLO-Polymer - **Ayusman Sen**,  
Manfred Eich, Robert J. Twieg, and Do Y. Yoon

10:05      Second Harmonic Generation and the Linear Electro-Optic Effect  
in Poled, Doped Second Order Nonlinear Optical Polymers -  
**Hillary L. Hampsch**, Jian Yang, George K. Wong, and John M.  
Torkelson

10:25      Break

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Tuesday, April 24, 1990 - Morning Session (continued)

$\chi^{(2)}$  Polymers - Gary Bjorklund, presiding

- 10:40 Functional Waveguides with Optically Nonlinear Organic Materials  
- **K. Sasaki**
- 11:10 Influence of Electron Withdrawing Groups and Molecular  
Conformation on the Nonlinear Optical Response of Derivatized  
Phosphazenes - **G.J. Exarhos** and **W.D. Samuels**
- 11:40 Nonlinear Optically Active Polyphosphazenes - **Alexa A. Dembek**,  
**Chulhee Kim**, and **Harry R. Allcock**
- 12:00 Side-Chain Polyacrylates with 4-Dimethylamino-4'-  
stilbenecarboxylic Ester Mesogens - **Mingyang Zhao** and **Warren  
T. Ford**

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**Tuesday, April 24, 1990 - Afternoon Session**

**Orientational Considerations - John Sohn, presiding**

- 2:00    Opening Remarks - John Sohn**
- 2:05    Approaches for the Design of Materials for Nonlinear Optics - M. Lahav**
- 2:35    Control of Symmetry and Asymmetry in Hydrogen-Bonded Organic Solids - Margaret C. Etter**
- 3:05    Molecular Orbital Modelling of Aggregation of Monomeric Units in Materials with Potentially Nonlinear Optical Properties - J.J. Dannenberg**
- 3:25    Break**

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Tuesday, April 24, 1990 - Afternoon Session (continued)

Oriental Considerations - John Sohn, presiding

- 3:40 Design of Ferroelectric Liquid Crystals for Electronic NLO Applications - **David M. Walba**, M. Blanca Ros, Noel A. Clark, Renfan Shao, Kristina M. Johnson, and Michael Robinson
- 4:10 Chromophoric Self-Assembled Multilayers. Organic Superlattice Approaches to Thin Film nonlinear Optical Materials - **D. Li**, M.A. Ratner, T.J. Marks, J. Yang, C.H. Zhang, and G.K. Wong
- 4:30 Synthesis, Poling, and Second Harmonic Generation of Nonlinear Optical Chromophores in Photocrosslinked Matrices - **Douglas R. Robello**, Michael Scozzafava, Craig S. Willand, and Abraham Ulman
- 4:50 A Promising New Acceptor for Nonlinear Optical Materials; Observation of High SHG and Control of Alignment in One Dimension by Introduction of Cyclobutenediones - **Liyong Sun Pu** and Itsuro Ando

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Wednesday, April 25, 1990 - Morning Session

$\chi^{(3)}$  Polymers - Donald Ulrich, presiding

9:00 Opening Remarks - Donald Ulrich

9:05 Shaping of Macromolecules and their Spectral Properties for  $\chi^{(3)}$ -  
Processes - G. Wegner

9:35 Third-Order Nonlinear Optical Properties of Organic Materials -  
Toshikuni Kajino, Takashi Kurihara, and Ken-ichi Kubodera

10:05 Polymeric Materials for Nonlinear Optics Derived from Ring  
Opening Metathesis Polymerization of Substituted  
Cyclooctatetraenes - Robert H. Grubbs, Christopher B. Gorman,  
Eric J. Ginsburg, Seth R. Marder, and Joseph W. Perry

10:35 Break

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Wednesday, April 25, 1990 - Morning Session (continued)

$\chi^{(3)}$  Polymers - Donald Ulrich, presiding

- 10:50 Polymers and a Molecular Crystal with NLO Properties - **F. Wudl**,  
P.-M. Allemand, and G. Srcianov
- 11:20 Liquid Crystalline Polymers with Conjugated Mesogenic Groups -  
**T. Mates** and C.K. Ober
- 11:40 The Nonlinear Optical Properties of Sigma Delocalized Polymers -  
**R.D. Miller**

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Wednesday, April 25, 1990 - Afternoon Session

Inorganics and Semiconductors II - Robert Laudise, presiding

- 2:00 Opening Remarks - Robert Laudise
- 2:10 Current Limitations and Future Opportunities for Nonlinear Optical Materials - Alastair M. Glass
- 2:40 Development of New Nonlinear Optical Crystals in the Borate Series - Chuangtian Chen
- 3:10 Strategy and Tactics in the Search for New Harmonic Generating Crystals - Stephan P. Velsko
- 3:40 Break
- 3:55 The Influence of Cation Coordination on Optical Properties in the System  $\text{MTiOAsO}_4$  - Mark L.F. Phillips, William T.A. Harrison, and Galen D. Stucky
- 4:15 Defect Chemistry of Nonlinear Optical Oxide Crystals - Pat Morris
- 4:45 Defect Properties and the Photorefractive Effect in  $\text{BaTiO}_3$  - Barry Wechsler, Robert Schwartz, Daniel Rytz and Marvin Klein

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Crosslisted by the Division of Polymer Chemistry

Thursday, April 26, 1990 - Morning Session

Organometallics - Seth Marder, presiding

- 9:00     Opening Remarks - **Seth Marder**
- 9:05     From Molecular to Supramolecular Nonlinear Optical Properties -  
          **J.-M. Lehn**
- 9:35     Nonlinear Optical Properties of Molecular Materials based upon  
          Rydberg Orbitals - **Jacques Simon** and **Patrick Bassoul**
- 10:05    Transition Metal Acetylides for Nonlinear Optics - **Todd B. Marder**,  
          Gerry Lesley, Zheng Yuan, Helen Fyfe, Pauline Chow,  
          Graham Stringer, Ian Jobe, Nicholas J. Taylor, Ian D. Williams,  
          and Stewart Kintz
- 10:25    Organometallics as Nonlinear Optical Chromophores: A  
          Theoretical Analysis - **D.R. Kanis**, **M.A. Ratner**, and **T.J. Marks**
- 10:45    Break

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**NEW MATERIALS FOR NONLINEAR OPTICS**

Seth R. Marder, John E. Sohn, and Galen D. Stucky, organizers

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Thursday, April 26, 1990 - Morning Session (continued)

Organometallics - Seth Marder, presiding

- 11:00  $\chi^{(3)}$  Measurements on Resonance Enhanced Organometallics -  
C.S. Winter, S.N. Oliver, J.D. Rush, A. Underhill, and C. Hill
- 11:30 Synthesis of Organometallic and Polymeric-Organometallic  
Materials for Nonlinear Optical Applications - Michael E. Wright
- 11:50 Second Order Nonlinear Optical Properties of Donor- and  
Acceptor-Substituted Organic and Organometallic Compounds -  
W. Tam, L.-T. Cheng, J.D. Bierlein, L.K. Cheng, Y. Wang, A.E.  
Feiring, G.R. Meredith, J.C. Calabrese, and G.L.J.A. Rikken

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Thursday, April 26, 1990 - Afternoon Session

Contributed Papers - John Sohn, presiding

- 2:00    Enhanced Stability of SHG by Cross-Linking of Chromophore-Functionalized Poly(p-hydroxystyrene) during *in-situ* Corona Poling - J. Park, C. Ye, T.J. Marks, J. Yang, and G.K. Wong
  
- 2:20    Poled Polymeric Nonlinear Optical Materials. Chemical Incorporation of High- $\beta$  Chromophores into a Crosslinking Epoxy Matrix - M.A. Hubbard, T.J. Marks, J. Yang, and G.K. Wong
  
- 2:40    Organic Polymers as Guided Wave Materials - Keith Horn, Karl Beeson, Michael McFarland, Ajay Nahata, Cheng-jin Wu, and James T. Yardley
  
- 3:00    Theoretical Nonlinear Polarizabilities of PN Compounds - S.M. Risser and K.F. Ferris
  
- 3:20    Optical Properties of Inorganic Polymers - Kim F. Ferris and Steven M. Risser
  
- 3:40    Break

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Thursday, April 26, 1990 - Afternoon Session (continued)

Contributed Papers - John Sohn, presiding

- 3:55 Conducting Polymers in Sol-Gel Matrices - Third Order NLO Effects - E.T. Knobbe, F. Nishida, P.D. Fuqua, B. Dum, B.M. Pierce, E.W. Chang, and R.B. Kaner
- 4:15 Single Crystal Growth and Structures of the Pyridine Clathrasil Dodecasil-3C (ZSM-39), A New Nonlinear Optical Material - H.K. Chae, W.G. Klemperer, D.A. Payne, C.T.A. Suchicital, G.W. Wagner, and S.R. Wilson
- 4:35 Synthetic Manipulation of Domain Structure in Clathrasil Single Crystals, A New Class of Nonlinear Optical Materials - H.K. Chae, W.G. Klemperer, and C.T.A. Suchicital
- 4:55 Second Harmonic Generation by Self-Aggregation of Organic Guests in Molecular Sieve Hosts - S.D. Cox, T.E. Gier, and G.D. Stucky